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III.—*On the Glaciers of the Mustakh Range.* By Captain H. H. GODWIN-AUSTEN, F.R.G.S., Bengal S.C., late H.M. 24th Regt., Assistant in the Great Trigonometrical Survey of India.\*

*Read, January 11, 1864.*

My duties as assistant in the great trigonometrical survey of Kashmir first took me amongst the wild valleys of Baltistan in 1860, and during the summer of that and the following year I was occupied in surveying the vast glacier-system of the Karakorām Range. I shall not here detail the march of 20 days from Srinagar in Kashmir to Skardo in Thibet. It is a well-known road, long since described by Mr. Vigne and Dr. Thompson, and is now very frequently travelled over.

The mountain-survey work of 1860 did not begin till the 5th of August; on that day, my party and I crossed the rapid currents of the Indus and Nubra rivers, on a zuks or native raft, made of goat-skins filled with air, over which are laid a few light poles of poplar. From the village of Kiris we commenced the ascent of Bianchu, starting on the 6th a little before sunrise. The pull up to the peak was most laborious work; 16,000 ft. elevation, that of Kiris below being 6800, giving a good 9000 ft. for the ascent. From Kiris I next followed up a large stream for a day and a half, and at the head of the valley crossed the pass, over a glacier into the Thüllè valley, which, at its upper end, branches off in three directions. At the extremities of two of these are passes into Shigar. I crossed over both, and found that they have small glaciers. The third branch presents a much more imposing mass of ice, which comes tumbling down a steep descent, and at its termination is split into three by projecting masses of rock. I remained at this place till the 13th. In its lower ground the Thüllè valley is well cultivated for wheat; but it looks bare, as there are no trees except a few willows; the river is a tributary to the Nubra. For two days my march lay along the Nubra River, whence I turned off up a ravine on the left, leading towards a pass over a ridge into the Hushè valley. From this ridge we had to climb two pretty high hills, one

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\* On the completion of the work connected with the measurement of the Karachi base-line, Lieut.-Col. (now Major-General) Sir Andrew Waugh, B.E., then Surveyor-General of India, deputed Captain Montgomerie, B.E., to proceed with the Kashmir series of trigonometrical observations. In the years 1855-6, the triangulation was carried into the heart of Kashmir, and by 1859 had been extended into Thibet. The names of the various assistant-officers, military and civil, who were engaged in this work, and the difficulties as well as hardships which were attendant on the survey of this elevated and remote region, are fully recorded in the several Reports of the Surveyor-General to the Government of India, and were noticed by the Earl de Grey in his Presidential Address to the Royal Geographical Society in May, 1860. (Vide 'Journal of the Royal Geographical Society,' vol. xxx. p. clxx.)



$7|6^\circ$ 

*Surveyed by Capt<sup>n</sup> H. H. Godwin-Austen.*

English Miles.

Camps marked thus ..... C.





76°  
 76° 30'  
 ap of the  
 H RANGE (TRANS-INDUS)  
 and  
 KARDO & c.  
 H.H. Godwin-Austen.  
 Miles.

15 20  
 thus ..... c.













of which is known as Lanzopheuma. It took us two hours from the camp below to get up to the pass, and six hours more to gain the peak; it was a severe pull up. The view which I thence obtained of the Karakorām Range, rising to 22,000 ft., with fine needle-like forms, was truly magnificent; and yet these mountains were only the spurs which ran down from the great masses beyond them.

The 17th brought with it a hard day's work; starting early, we first crossed a ridge which separated us from a ravine beyond; up which, at its head, was a fine peak called Chungoksigo, and which had to be ascended, as it commanded a view of the country beyond the valley. Our way at first was over a broad snow-bed, and then across a slope of loose débris of slate-rock which lay at an angle of  $45^{\circ}$ . The ground was continually sliding away; the whole mass seemed full of snow or ice in a melting state. However, we managed to reach the summit about 1 o'clock, and crossing over I set up the plane-table, overlooking a ravine on the other side, down which went a small glacier. There was a sharp point of rock some few hundred feet higher than the ground we were on, and as I had sketched in all that I could see below me, we determined to go to it. Our way was over snow, and somewhat difficult. After a while it became so steep that we had to cut steps for the remainder of the way. Finally we reached the point; it raised us altogether clear of the ridge, and I was amply repaid for all the labour by the magnificence of the view. Below was a glacier with all its crevasses and varied features laid out—as on a map: to the left was Zoah, 21,000 ft., right ahead up the Hushè valley was Masherbrum, rising to 25,000 ft., with its pink-tinted rocks shining out in warm contrast with the masses of snow which rested on its sides. Our descent was at first much more expeditious than our ascent had been; lying on our backs, we shot rapidly down the snow-slopes, but the subsequent journey over the loose débris was far worse than the labouring-up had been.

On the 18th and 19th we proceeded along the Hushè valley amidst most splendid scenery, the lofty peaks rising up on either side, and with the most fantastic forms. The river, above the village of this name, consists of three branches; the terminations of large glaciers being visible up the valleys on the left. I began with the valley on the right, and by evening reached the foot of the glacier (Atoser gl.) which comes down from Masherbrum.

On the morning of the 20th I started up the moraine of the glacier, and managed to scramble along for about 6 miles, when the surface of the ice became so broken that it was impossible to proceed. This glacier is continued for 6 miles further up to the ridge, which on its northern face gives off another great glacier, some 15 to 18 miles in length.

I next followed up the main stream of the Hushè River, which

issues from a cavern at the foot of a very much larger glacier than the preceding. Some 5 miles up, this glacier forks, each branch being about 7 miles in length; one of them is heavily laden with *débris*, some of the blocks being of enormous size, whilst the other is quite clean, with only a narrow dirt-band running along one side. On one side of this laden glacier, which I propose to distinguish as the Masherbrum Glacier, was a lake, of which the boundary on one side was a vertical cliff of glacier-ice, a great mass of which broke away as we were returning, and went down with a bang and a splash into the smooth lake beneath.

On the 23rd I followed up the third glacier, which is of much greater thickness than the others, and carries an enormous load of rocky *débris*; there is a fourth large glacier connected with the sources of the Hushè River which I tried to explore, but the sides were so steep that we could not get upon it at all.

The survey work being finished, I descended the Hushè River to its confluence with the Nubra. The Hushè is joined below, on the left bank, by the Saltoro, a large river which evidently comes down from some distance, but which I did not explore on our way down. From Kapaloo to the junction of the Indus with the Nubra is 24 miles. The following morning we crossed the Indus to the left bank, and another march of 24 miles brought us into Skardo.

In measuring off my work I found that in 23 days I had surveyed 1250 square miles of a very mountainous country. The survey of the Hushè valley was completed; it is a district which presents a very varied character of scenery, from villages surrounded with stately trees and luxuriant vegetation, up to regions of desolation, of lofty snow-clad peaks, and vast glaciers.

I made a short rest at Skardo. As it at first presents itself, with its great overhanging rock rising from out the broad level valley of the Indus, it is picturesque and striking; but the place itself is small and uninteresting.

My next start was from Gol into the hills, to the south of Skardo; in the course of this part of the survey I had two good mountain-climbs—one up a peak of the name of Gommathaumigo, with an elevation of 17,500 ft.; from its summit, if the weather be clear, there is a magnificent view of the Karakorām mountains, or rather of that portion known as the Mustakh; but presenting at this distance only great masses of everlasting snow, from off which rise several fine peaks to the west, and deep in the distance below lies the Skardo valley, and its junction with the Shigar.

I returned to Skardo, where I crossed the Indus in a boat; this being the highest part of its course at which a boat is to be met with. We went on at once to Kuardo, the peak above which we endea-

voured to ascend, but were unable to do so, owing to a recent five days' fall of snow.

On the 18th September I went on into Shigar, and thence up a tributary from the eastward for two marches, ascending a peak at its further end. I here came upon a mass of slaty limestone-rocks swarming with encrinurites and other palæozoic fossils, the occurrence of which at this place, and near Kashmir as well, seems to elucidate the general geological structure of this portion of the Himalayan chain.

There was yet time for another departure from Shigar; so, starting along the left bank of the river, we followed it upwards for three days, crossed on goat-skins a little above Chutrun, and thence up the Gunto La (or Pass) to Rondu. From this position I obtained fine views up towards the high pass into Nagayr and of the country to the west, which as yet is only known to us by native reports; but the season for surveying was now over.

Preliminary to the survey work of 1861, I had to visit several peaks in the neighbourhood of Skardo; one of these, Thyarlung, a principal trigonometrical station of the Kashmir series, is situated close to the watershed of the Indus on the north, and on the edge of the plains of Deosai; and, though in sight from Skardo, it took me a long round to reach it, as I wished to visit the Boorje La (or Pass) on to the road to Kashmir, in order to ascertain its elevation.

On the 7th of July, my camp marched through Skardo and thence to Kûrpito, a small village at the entrance of the ravine which leads up to the Boorje La. The road up the ravine is good, and the ascent steady, with precipitous spurs of slate-rock on either side; as several coolie-loads were behind, I made a halt at Chogochu-mik (the great water-eye, or spring), for at this spot the stream which for full a mile has been buried beneath the talus from the hills, gushes out as pure as crystal.

On the 8th we started early, the road still good. Soon after quitting our camp-station, the birch and junipers were left behind, and the ravine assumed a drearier aspect. Beyond our break-fasting-place, near a frozen snow-bed, the ascent became very fatiguing. After crossing some snow and a rough stony slope beyond, the pass was at last attained, at an elevation of 15,878 ft. or 8800 ft. above the plain of Skardo. From this position there is a commanding view over the Deosai plains, a curious undulating region of round-topped granite hills, encircled by lofty snowy peaks: winding rills, issuing from tarns of emerald-green water, set in snow-beds, are the only other features of this curious scene. Not a bush, nor the slightest trace of vegetation, was to be seen, whilst

the sienna tint of the weather-worn granite surfaces, which pervaded everything, added to the extreme desolation of the scene. During the ascent of the Boorje La, my pulse beat 138 in a minute, that of a Balti, 104.

The first part of the ascent of Thyarlung was grassy, then over small loose débris of rocks which became sharper as we neared the summit. Three hours and a half, however, of steady walking brought us to the summit, 16,844 ft. by trigonometrical levelling. The view, as usual from these great altitudes, was grand and magnificent; but it cannot be said that it was picturesque, being thrown too high above all the valleys, and the horizon on the high peaks lying away to the north and east—but grandly they looked, with not a cloud in the sky. Peak K 2, the highest on this side (overtopped only by Mount Everest in the far eastern Himalayas of Nepal), appeared of an airy-blue tint, surrounded by the yellower peak K 1 (Masherbrum), K 3, and others, all over 24,000 ft. in height. Other minor peaks, by hundreds, thrust up their heads—some snow-capped, some rounded, some bare and angular, running up as sharp as needles.

It was a splendid day, too fine to last as it proved, when we left the Bandè Loombah and marched up to the end of the small glacier at its head; then turning to the left we ascended the Thyarlung ridge, here low, to the Shigar Luggo (Passage). Thence the descent is very steep and bad just below the ridge, and becomes excessively stony beyond, being over moraines from the small glacier of the second order at this place. This glacier has evidently at some former time been much longer than it is at present, whilst, in addition, the snows in winter bring down great masses of débris which lie strewn over the lower slopes and bottom of the ravine. For some distance down, as in the case of the Boorje Loombah, the stream is not visible, till on reaching the end of the rough débris it gushes out in full strength, rushing and tumbling down towards the village of Shigāri in the Skardo plain.

This village of Shigar is situated on an immense unstratified accumulation of earth and angular débris, which juts out into the plain, the work of olden glaciers. Taken altogether, this valley of Skardo is a curious study, from the many and great physical changes it has undergone since the mountains were first raised, as they now stand about it.

The height of the upper lacustrine deposit at Kuardo is quite 4000 feet above the present river, and this deposit also rests on the rock of Skardo in the town. This attracts the attention at once, for it indicates plainly that the whole breadth of the valley has at some time been filled up to that level.

The clay deposits nearer the level of the present river, and through which it has cut its course, show that once this Skardo



basin contained a vast lake with swampy grassy margins, long subsequent to the time when the higher deposits were settling down in the first deep lake. The eye of a geologist is not needed to trace these past conditions and changes: there are the shells, there are the crumbling stems of the plants and the fragments of wood, not in one stratum only, but first one, covered by three or four feet of sand and pebbles, then another. This succession can be traced over large areas throughout the lower lacustrine deposit, wherever it is cut through by the present drainage lines of the valley, and can be best seen from Kipchun across the valley to Kuardo, and thence up the Shigar River, near the village of that name—everywhere at a uniform level. The temperature of this region, too, has undergone great changes ever since the period of the lower lacustrine deposit. At the village of Kipchun the terminal moraine of a great glacier from the gorge above juts out a full quarter of a mile into the plain, with its great blocks, just as the ice-mass threw them off. This moraine rests on the deposit of valley sand, whilst the lacustrine beds of Kuardo are hundreds of feet above. In this gorge and then some eight miles higher up there is now only a frozen snow-bed.

Ever subject to the great cataclysms of the Indus and its tributaries, more especially from the side of the Nubra and Shigar, with their glacial sources, the plain of Skardo has undergone changes even within the memory of man. The waters from many sources rush in here and spread themselves over the plain, and any obstruction in the narrow gorge towards Ronyūl retains them. This happened in 1841, when a great flood from the Nubra valley did irreparable mischief. At that time the plain opposite the village of Kuardo was cultivated and well wooded—the site of two or three villages—these the flood added to the spoil from above. At Komāra, where the river narrows, the whole was arrested, forming a tangled mass, which caused the waters to rise and remain pent up for nine days over the plain of Skardo. With what terrible effect the body of water which had thus accumulated burst its barrier is still remembered at Attock, where hundreds of men and women, the tents and cattle of the camp of Golab Singh, were swept into the Indus.

From Shigāri the road to the ferry over the Indus at Kapashna is across sandy flats, which stretch as far as the village of Hoto. In many places sand-dunes, with their steep slopes to the east, show the prevailing winds to be down the valley.

A short distance above the spot where the boat leaves the Skardo shore the muddy waters of the Shigar River come sweeping down, forming strong eddies and even considerable waves when both rivers are high. The sandbanks are continually shifting, and our boat was constantly aground; but by hauling and pushing, the

boatmen jumping into the water on these occasions, the opposite bank was at last gained.

On landing on the right bank I rode on to the village of Kuardo, which lies along a ravine, bounded on the west by a high hill of alluvial deposit and on the north and east by spurs from the peak of Mashkulla. This mountain had to be ascended, being the second step necessary for fixing the positions of the high peaks ahead; but the ascent was obliged to be deferred till the 15th, as the mountains around were all hidden in thick clouds.

In spite of a somewhat scanty supply of water for irrigation, without which nothing will grow in this region, the village of Kuardo is beautifully wooded and green: fields rise in terraces for a distance of two miles along the valley; the houses are scattered about them, surrounded by fruit-trees—apricot, mulberry, walnut, apple; willows are common. The vines are planted at the foot of the trees, and hang in festoons from the branches; they bear largely. The field cultivation consists of wheat, cockscomb, tromber, and barley. Excellent gourds, melons, cucumbers, turnips, &c., are grown in the gardens. The water flows in artificial channels through the fields, and the supply being small, it is economised by being collected into some large tanks, with sides built of boulders and earth, from which a certain quantity is allowed to each Zemindar. The houses, in sets of about eight or ten, are built in two stories: the ground-floor walls are of the rounded stones from the ravines, with mud, or of sunburnt bricks of large size, cut out of the hard lacustrine clay. This lower story is usually about ten feet high, and is either used in the winter as a residence, or serves for the cattle, sheep, and goats. The walls of the upper story are made of strong wicker-work, often double, and well plastered with mud. The upper story does not cover the whole of the lower; but a portion is left with a flat roof, where the owners usually sit, and where they clean their grain. In the better kind of houses the upper story is of wood. The ascent to the houses is by a ladder from the outside, so that the inmates in a measure are secure. The crops are often stored up, as small ricks, on the roofs, as also the grass for the cattle, where it is close at hand during the winter, when the ground is wholly covered with snow. The women clean the grain, and, with the exception of ploughing, do as much of the out-door labour as the men, even carrying heavier loads. When cattle are scarce it is not unusual to see a couple of men harnessed to a plough. The fields are kept exceedingly clean, and are well manured.

During the apricot season the large rocks and the roofs of the houses are covered with the fruit, and in two or three clear days become sufficiently dry to be packed in skins; they are then called “khobanies,” and form a very considerable article of consumption in

the country: the better sort are exported to Ladak, Astore, and Kashmir. The process of making khobanies is by half splitting the apricots and taking out the stones: several are then inserted, one inside the other, with a sweet kernel in the centre, and they are thus dried in the form of small balls. When required for use they are put to soak in water overnight, and eaten with chupatties next morning.

On the 15th of July the clouds cleared away a little, and starting early we were soon beyond the fields which lead up to the grazing-grounds above. The lower part of this ravine is most curious, it being extremely narrow, from 10 to 14 feet wide, while cliffs on either side rise to between 400 and 500 feet. The cliff to the left is of hard sandstone and conglomerate with huge blocks; the beds are nearly vertical: on the right are metamorphic slates at a high angle. On reaching the upper surface of the alluvial deposit, high pillars of clay, each capped with a large rock, are to be seen, and have a strange appearance. The oldest men of the country say that these have not altered in the least in their time; their grandfathers have told them the same. Some of the taller and more remarkable bear names. The top stone has served as an umbrella to the column of earth beneath, and in a country, where heavy rain is the exception, they may continue as they are, for there is nothing to destroy them.

At an early hour the next morning (16th) we were climbing up the rocky and extremely steep slope, in intense cold. As the ravine faced the west, it was long before the sun rose high enough to throw its rays upon us; but when at last it peered over the wall of rock above us, a burst of joy greeted it from every mouth. As we drew on towards the summit, the actual elevation, as well as the steep slope, made the ascent fatiguing; but once passed, the way along the ridge to the trigonometrical station, to my surprise, was quite level—a few snow-beds only remained.

The view from the station is magnificent, up the Shigar River and down over the whole plain of Skardo, backed by the mountains of the Deosai Plains. The snowy range was only visible here and there amongst the clouds, which were gathering up fast, and I soon saw that a descent that day was out of question. We made ourselves as comfortable as it was possible to do; the plane-table was set up, and as much as could be seen cut in at once. I got into a snug corner out of the wind, and then the day was spent in sundry rushes to the plane-table, whenever, on looking round, some peak would show out from amongst the heavy clouds which hung about. Many such days as these—days of long dreary hours—have to be passed amongst the Himalayas. Our altitude was 16,919 feet.

The frost in the course of the night was severe, and at sunrise

next morning the thermometer showed 32° 5'. Next morning, as the light in the east grew stronger, the view was one never to be forgotten. From the south-east to north-west the whole range of snowy mountains was visible, with only a few streaky purple clouds lying beneath them, which, without obscuring any of their sharp forms, added to their immense heights. K 1 (Masherbrum), and K 2, the second highest in the world, overtopped them all, and were conspicuous from their fine shapes.

Down below, the valleys were all in deep shade, and all around was deadly still, save now and then the cry of the snow-partridges, as they came up the hill-sides to bask on the ridges in the early sun. The sound of rushing water far down in the ravines below only just reached us, and the higher streams were all silent.

The sun now rose from behind the Mustakh, and then all became hidden in the intense glare. The clouds formed up wonderfully fast, and in another hour all the peaks to the north-east were obscured. West by south Nanga Purbet (26,629 feet) showed its great rounded form above the snowy ridge of the Alumpi and Bunnok La, and to one unacquainted with the ground would have been taken for a part of it, though 30 miles beyond. We then retraced our steps to the camp below.

On the 18th we left Kuardo for Shigar, skirting the foot of the hills, through the village of Strandokmo, and crossing the Shigar River to the left bank. Here rain and cloudy weather detained us twelve days.

On the 28th of July we removed to a pretty spot, consisting of some twenty houses called Skoro, which gives the name to the large ravine running up to the Pass over into Braldoh. The evening of the 29th was beautifully clear, and it was evident that a break in the weather had taken place, so the following morning our camp was struck, and I started early up the ravine. Provisions for four days were taken, and Mahomed, son of a petty wazir of Shigar, a fine young fellow, offered to come with me. The walking as far as the Nang brok was fair, after that it got very bad. We reached, the first evening, a grazing ground, called Kutzah, 12,553 feet in elevation, and found several fine Yak grazing on the hill sides above our camp.

Whilst lying in my tent, after finishing up my work, I heard an unusual rumbling sound, and on going out I found all the men were wondering what it could be. After a few more seconds of suspense, some Balti coolies, who were cutting brushwood higher up the ravine, shouted out that the stream was coming down, and in a few seconds more we saw a black mass coming out of a lateral ravine from the right, and moving rapidly over the broad slope of boulders which formed the bed of the valley. Before the black stream reached us it divided into two, and we then saw that it con-



sisted of a mass of stones and thick mud, about 30 yards in breadth, and about 15 feet deep. The servants by the side of the little rill near the tents had just time to escape before it came down upon their fires. It was a most wonderful sight: a great moving mass of stones and rock, some of great size, measuring 10 feet by 6, all travelling along together like peas shot out of a bag, rumbling and tumbling one over the other, and causing the ground to shake. The large rocks lying in or near the edge of this moving mass would receive a few buffets, totter a little, and finally roll in amongst the rest to carry others away in turn. No one, who has not seen a flood of this kind, can form any idea of the mighty power of transport which the accumulated masses of water and melting snow acquire at these times, and I was almost bewildered by the spectacle.

Our first alarm happened about six. Shortly after another body of stones came down, not so large as the first, but travelling much faster, as it took the bed of the first and so met with fewer impediments. These "shwās" are of frequent occurrence in the ravines, particularly when the sides are of crumbling rock; they originate in land-slips, which stop the streams for a time, and often assume such a size as to cause great injury to the cultivated tracts and villages below.

I started at daylight on the 30th, and after crossing the path of the rock-stream of the previous evening, commenced the ascent of the spur from the Skoro La, which, though grassy, was very steep. At 11 A.M., after having come up 4090 feet from our morning station, we gained the Pass, 16,644 feet. Beyond was a wild and desolate scene of huge jagged rocks rising out of the snow, from which a glacier stretched away to the north. This glacier, though not of the largest size, is a very perfect specimen, running up to an elevation of 19,000 to 20,000 feet towards the high peak Trans-Indus 13, or Mungo Gūsor. Its length from the Pass to its termination is rather more than 6 miles. Very little of the Braldoh valley was visible, but some of the high peaks beyond.

Opposite the village of Askolè the Braldoh is crossed by a rope-bridge, 270 feet in length. This fine tributary to the Indus is here a roaring boiling torrent, of an ochre colour, showing that its glacier sources are not far distant. The bridge is composed of nine ropes as a footway, with nine sets on either hand to hold by: the ropes are made of birch twigs. The passage across was by no means pleasant.

The country on this side was even more bare and rugged than that about Skardo: all the high points around were snow-clad, and glaciers of the second order filled the upper portions of all the ravines. Askolè is the furthest village on the right bank of the Braldoh, and contains about twenty dwellings. A few willows are

the only trees to be seen. Some older and larger than the rest, surrounded by a wall, and called the "Bagh," were assigned to me, under which to pitch my tents. Save M. A. Schlagentweit (afterwards killed in Yarkund), I was the only European that had ever been seen there, and my arrival was an event in this remote spot.

The weather cleared in the evening. The next morning broke without a cloud, and an early hour saw our large camp of 66 men getting under weigh. Leaving the village, we passed out between two small guard-towers, substantially built of stone and timber, and which served in former days as a defence against the people of Nagayr. About 2 miles on, where the path leads along the face of a cliff washed by the river below, there is another tower, with a steep and difficult approach. On the exposed side twenty men might hold a large force in check. They told me here that the Nagayr men once surprised and carried off the guard by ascending the mountain above and taking the tower in rear. For guides I had two good Shikaries, men who knew the country well, and who had been into Yarkund.

About noon we reached the foot of the immense glacier of Biafo, which terminates at an elevation of 10,145 feet. Its broad belt of ice and moraine, stretching right across the plain for more than a mile and a half, completely hides the river which flows beneath it, the terminal portion of the glacier abutting against the cliffs on the opposite side of the valley. Two rivers issue, one on the extreme right, the other on the left. I took that on the right, which comes rushing out of an enormous cavern, at a short distance from which we mounted the glacier, up steep masses of large débris and slopes of ice. On reaching the more level portion of the glacier, no trigonometrical points being visible, it was necessary to climb a high spur to the west. By 2:30 we had gained a point 2500 feet above the glacier, and whence we had a good view of it, but as it trended a little to the north-west, it was hid for the greater part of its length. From this station several known peaks showed their heads, which enabled me to carry on my work with good accuracy.

That night's camp was on a sandy plain, which was covered with wild currant and dwarf juniper bushes, and only a little rill trickling from the glacier separated us from it. The night was frosty. The way near the junction of the Braldoh and Biaho rivers was difficult for about 2 miles, there being hardly room in some places for the feet. After rounding a point the river turns to the north, and, the track descending to it, there is fairish walking, over sand and boulders, but here and there small branches of the river have to be forded. Onwards from this the river narrows, and we frequently had to take to the water, as we came abreast of each lateral ravine, the streams down which were now in full force, having their sources in

small glaciers of the second order. From the terminal moraines which abutted on the main river, it was very evident that at some time glaciers had descended the whole length of the lateral ravines. A great flood of water-borne detritus had just rushed out of one of these ravines, the muddy water of which was still flowing on as we arrived at its bank.

We encamped at a spot known as Tsok, where one of the main glaciers of the river (Biaho) comes into view. This glacier leads up to the Mustakh Pass: and every ravine had its strip of ice extending down to the river, or very near it, and running upwards some 5 or 6 miles.

On the morning of the 4th I ascended the ridge above our camp, whence I got a first view of a magnificent glacier, with three large feeders stretching away beyond it, the sources of the Biaho river. I wished to gain the range at the head of the spur, but the ice was so steep that it was altogether impossible. From this point the Punmah glacier is seen in great beauty: it terminates in an enormous chaotic expanse of débris, the lines of moraine not being distinguishable from one another for some miles up, where they run on till they end in a few narrow bands of dirty ice. Except for a few black slopes of ice and the terminal cliff with its caverns and black rents, one could hardly, even on closer acquaintance, believe a glacier to be there, so completely is its lower portion concealed beneath the materials it has brought down.

After finishing my work, and taking a sketch of the view upwards, I descended in the direction of a much broken glacier which comes from the north-west. This glacier has in some past years been upwards of 100 feet thicker than it now is, as shown by its lateral moraines, and the grooved and scratched rocks on either side. Past the terminal moraine of this lateral glacier a level plain extends for  $2\frac{1}{2}$  miles to the foot of the great Punmah glacier, the elevation of which is 10,318 feet. Here our camp was pitched just beyond the reach of the blocks and stones, which, detached by the melting of the ice, kept incessantly coming down the ice-cliff, now one or two at a time, and now in great masses. As we sat over our fires, the noise was to be heard late into the night, but at longer intervals as the night advanced. We were now fairly within an ice-bound region, which for bleakness and grandeur is perhaps not to be surpassed: its glaciers exceed those of any of the mountain-ranges of the world, and are equalled only by those of arctic or antarctic regions, for though the Himalayas of Nepal are quite as high as those of the Mustakh, yet being so much further south, and of less breadth, the glaciers have not a like extent.

Starting upwards from Punmah, the track skirts the right bank of the glacier for a distance of 2 miles, following the hollow way

between the mountain on one side, and the loose stony slopes of detritus, shed off from the glacier, on the other. This glacier is on the advance, together with all its detritus. This was obvious at once, from the covered scrub and upturned turf immediately in front; and the vast power with which it moved was well displayed at one place, where a hill of stones and earth projected out a little. This was rent a long way down, and was fast giving way before the advancing moraine. The thickness of the ice must have increased by from 60 to 80 feet, as the old camping spot of Punmah is now quite covered.

On the hill-sides were a few small shrubs of birch and juniper; clumps of the red rose grew close to the glacier. During the summer months the Yak are driven up to be grazed here and in the ravines about; they do not thrive in the villages lower down, where at times the heat is considerable, and where they are much teased by the flies. The half-breed between the Yak and the common cow, called Bzo, is a fine animal, and principally used for ploughing; these remain below. The cows of the Yak are not kept for their milk, the whole of which goes to the calves. The number of the pure breed is small, and nearly all are brought over from Yarkund. They are to be met with in all the high villages of Baltistan, but I never saw more than five or six together.

After passing the junction of the first considerable glacier from the left, called Dumùltèr, and which has its sources 8 miles up, our course lay over the uneven surface of ice and moraine, and after crossing this tributary, was again on terra firma, as far as the encamping spot of Chongnolter. The track lies so close to the steep slope of the transported blocks of the side moraine, that in spots there is considerable danger from the falling rocks. These are detached without any warning, and come tumbling down the incline; and we often had to make a hard run in order to pass ugly-looking slopes, where no footing could be obtained on the mountain-side. This camping spot is small: there was hardly room for the four tents; and the coolies found sleeping-places under the rocks around.

On the 6th I struck diagonally across the glacier towards the left bank, through as extraordinary a scene as the imagination could picture; it was the desolation of desolation. The lofty peaks above were cased in cloud, through the breaks in which their strange forms looked more gaunt and magnified in size. There was not a speck of green to relieve the great precipitous crags of grey and ochre. The surface of the glacier around us was either a succession of ridges more or less stony, or—when the lines of medial moraines disappeared—like a sea of frozen waves. Small pools of emerald-green water, with cliffs of ice, filled many of the hollows, while in some parts flowed streams of running water,

which generally ended abruptly, by discharging down some crevasse. On every side were heard the noises of falling stones as they rolled down the ice-slopes or dashed into the pools. From the base of the mountains on one side to the other, was a distance of over  $2\frac{1}{4}$  miles. We followed the left bank for 3 miles, along a more open track, and reached a camping spot called Shingchüki. The continual change going on in these regions was shown at this spot. Mahomed had told me that in front of the encamping-ground we should find a lake with possibly some duck in it, as he had shot a couple there on his last visit. On reaching the spot not a vestige remained; the glacier and its moraine now covered everything, and there was barely room for the tent between the mountain-side and the ice. Lower down we had passed a small piece of water, which was rapidly silting up from the sand and mud carried down into it from a small tributary glacier in the hills above. Every ravine here had its glacier, and many of these ran for 6 or 8 miles up amongst the sharp lines of peaks above us.

The next day was a halt, the weather was so cloudy that it was out of the question to think of making even a reconnaissance of the ground about us. About 6 in the evening we were surprised by the sudden appearance of four men from Yarkund, who turned out to be Baltis of Shigar and the Braldoh, who had emigrated to Yarkund some years back, and had now come over to see their friends on this side. I soon got into conversation, and learned from them a good deal about the country they had come from. The poor fellows had suffered a good deal while traversing the mountain portion of their route, having to travel by night and hide away during the day, on account of the robber tribes. These men wore the sheep-skin cap and long-skirted coat of Yarkund, with voluminous sleeves padded with cotton; thick leggings, and stout leather boots or pubboos, completed their somewhat stout appearance. The goodness of their clothing contrasted strongly with that of their brethren of Baltistan, and showed that emigration had been advantageous.

The 8th was still cloudy, so after a vain attempt to get an observation, the camp was struck, the little scrub was made up into fagots, and we started for Skeenmüng, where the glacier branches into two. It was not far, and in full view; but it was getting dark before we reached it. The first part of the way was very rough, over loose moraines; beyond, these became more separated, with clean bands of ice between. The ribboned structure of the ice was beautifully shown on this glacier, sloping inwards at an angle of  $32^{\circ}$ . Opposite Skeenmüng a large tributary comes down from the mountains to the south. Here the ice was again much broken, and we had to zigzag about the crevasses before finding a place where we could leave the glacier for *terra firma*.

Skeenmüng is a capital spot for a camp in this wild country. Luxuriant grass grew along the banks of a small stream, flowing from an old moraine, and which lower down flows in under the main Punmah glacier. The spur above the camp went up with a gradual slope to the rocky peaks above, the favourite resort of the Ibex, as its name denotes.

On the morning of the 9th, I proceeded with four men up the main glacier, which comes down from the mountains to the north, and which is known by the curiously-sounding name of Nobündi Sobündi. The way was dreadfully rough as far as a spur known as Drenmüng, and lay sometimes along the moraine, sometimes along the mountain-side. We passed the now dry bed of a lake 400 yards by 200, which had been formed by the pent-up waters of a side glacier, and which had been full 50 feet deep from the horizontal line its upper level had cut along the ice-cliff. Lying along the old line of its shore were some miniature icebergs, which had fallen from the glacier, been drifted away, and stranded where we saw them. Some of the blocks measured  $15 \times 18 \times 10$  feet. They were melting away, but had seemingly been there for some days. This same day we came across several broods of the gigantic Chicor, just able to fly, the old birds still with them. I shot three, and Mahomed, who got into a great state of excitement, caught two young birds that ran and hid under some stones. They are excellent eating, and were a welcome addition to our fare.

The view from Drenmüng was magnificent. Two stupendous peaks rose up from opposite sides of the glacier to 23-24,000 feet, covered with snow from base to summit. To the right the glacier ran up some 8 miles, backed by other enormous peaks; to the left the Nobündi Sobündi glacier, with a breadth of  $1\frac{3}{4}$  mile, stretched away 14 miles in a direct line, to where numberless other ice-streams meet to form it. The sun setting behind the line of snowy peaks in that direction, lit all up with a beautiful pink tint; whilst the rocks of the moraines, red, yellow, and green, heightened in colour by the wet, sparkled in the sunlight.

We now struck directly across the moraines for about half a mile till we reached the clear ice, which was traversed by numerous large streams, but with scarcely a single fissure. The streams, after running for some distance, and becoming very considerable, usually end in wells, down which the water falls with a roar. These wells seem to be of great depth. It was nearly dark when we again arrived opposite Skeenmüng, and now arose the difficulty as to where we should find a place at which to get off the ice, the side of which was a cliff upwards of 100 feet in height. After several unsuccessful attempts, with the darkness increasing, and all of us running here and there hunting about for a feasible spot,

one of the coolies at last found a way down a crevasse nearly filled with rocks, into which we went, and out of which we got on to a ridge, and thence to the ground below. Earlier in the day we should not have managed this, but now, fortunately, the stones had all become frozen to the surface, and afforded firm support to the feet. It was only with the last glimmer of twilight that we got off the ice. A little longer, and a night on the glacier, and without covering, would have been our portion; with the cold wind we should have been frostbitten to a certainty, and perhaps laid up for some time.

From the camping-ground of Skeenmüng there is a stiffish ascent to a fine peak above, which we mounted on the 10th. From below it seemed quite near, and I imagined that we should accomplish it quickly, and return again, but I was terribly deceived. The first part of the way was good walking, but as soon as we got on the talus of angular rocks it became very laborious, several of the men became ill with bad headaches and lay down, and we did not reach the highest accessible point till 3 p.m. This I found was 18,342 feet. It was a lovely day, every mountain around stood clearly out in view, with all its features distinctly seen; but I was disappointed that neither peaks K 1 nor K 2 were visible. The view up the Nobündi Sobündi glacier, to the great plateau of ice whence it takes its rise, was grand in the extreme, as also downwards along its whole surface to Chongulter. From this station the two reaches of this broad ice-river are seen at once to the south-east: the pass over the Mustakh was in view at the end of another lateral glacier of vast proportions. The great peaks of Trans-Indus, 4 and 11, were visible beyond a level plain of snow, at an elevation of 22,000 feet. It is a vast sheet of ice, with only a few sharp points of rock sticking out here and there. Snowy ridges stretched away towards Yarkund. We returned to camp in the evening.

On the 11th, the weather being still clear, we started early for the direction of the Mustakh or Pass over the Karakorām Mountains into Yarkund. "Mus" is snow, and "takh" pass, in the Yarkundi language. Our path lay along the ridge of an ancient moraine, now grown over with grass, and showing the great thickness which the glacier at some former time must have had. We quitted this at the camping-ground of Tsokar, where are some small tarns of crystal water, which give the name to the spot. Thence we proceeded over the ice, which here becomes nearly free from moraine ridges, though the surface was difficult from being broken into hollows.

The last camping-place on the Mustakh glacier is at a spot called Chiring, which we reached about 3 P.M.; the moraine here dwindles to a few scattered blocks on the surface of the ice. It



took some time to collect enough of these to form a flooring. This serves to keep off the cold; and as driving pegs was impossible, they served to tie the ropes to. The smallest patch of rock on which to put a tent would have been welcome, but such was not to be found. The mountains rose from the glacier in sheer cliffs. It was a case of a night on the ice, and no help for it. After sundown the cold became very severe. The coolies were not able to sleep the whole night through; for as our fuel had to be carried with us, no fires could be afforded except for cooking. We all went to rest early, and did not turn out till the sun showed over the immense cliffs above us, which was not till about nine o'clock.

Leaving camp, and taking with me eight men with ropes and other appliances, we started up the glacier, which is here about  $1\frac{1}{2}$  mile broad, with a slope of about  $8^\circ$ . For the first 3 miles the crevasses were broad and deep in places only, and we could avoid them by making detours. They soon became more numerous, and were ugly things to look into, much more so to cross—going down into darkness, between walls garnished with magnificent green icicles from 6 to 20 feet long, and of proportionate thickness, looking like rows of great teeth ready to devour one. I tried with our ropes to sound the depths of some of these fissures, but all of them tied together only made up 162 feet, which was not long enough. The snow lay up to the edges of the crevasses, and travelling became so insecure that we had to take to the ropes, and so, like a long chain of criminals, we wound our way along. In this mode we moved much faster, each man taking his run and clearing even broad crevasses, if they crossed the direction we were travelling. The snow was about  $1\frac{1}{2}$  foot deep, and hard when we started; but as the day advanced it became soft, and walking more laborious; besides this it would every now and then break and let us down to the hard ice below. The larger crevasses revealed themselves, but the surface snow hid all the smaller ones, and hence a feeling of insecurity. I kept some coolies ahead feeling the way, by probing the snow with the long poles we had brought with us; so our progress was provokingly slow. Under the pass the breadth of this ice-basin is two miles, with an undulating surface; small glaciers bring down their tributaries to it out of every ravine, and the loud reports of the snow falling from the cliffs around was heard unceasingly.

In spite of difficulties we had got on favourably till within a mile of the pass, when the clouds, which had been gathering fast, began to look so threatening that I thought it best to take the opinions of the men with me; and, guided by their experience, I gave up the idea of proceeding further. By the time the fire was lighted, and the boiling-point ascertained (which gave  $182\cdot8$ , air  $42$ , co r-

responding to 17,301 ft.), and other observations taken, all the peaks around had become quite obscured. The Pass was distant about 500 ft. above our turning-point; we had to beat a hasty retreat down towards Chiring, the snow falling fast. The glacier was making most disagreeable noises—crunching, splitting, and groaning to an awful extent—caused by the vast body of ice, 2 miles across, here forcing itself through a channel only a quarter of a mile broad, and with an increased slope. The only other European who had tried the Mustakh Pass was M. Schlagintweit, who was equally unsuccessful, clouds having driven him back, as they did in my case. I had gone as far as was necessary towards the parting ridge; still, I should have liked to have crossed the Pass; but want of time, there still being much work to be done, prevented another attempt. My great object had been to get a march along the glacier, and determine the ridges on the northern side. This is quite feasible, and with a small guard the survey might be carried into the Yarkund country for a considerable distance, as, from all the accounts I heard of the tribes, their numbers cannot be great, nor their matchlocks much to be dreaded. It was in a disappointed mood that I left Chiring for Punmah. We passed the night at our former camping-place, Skeenumüng, and the next day made a short march to Shingchukpi. As most of those who had gone up the Mustakh Glacier had sore eyes afterwards, it was advisable to keep quiet for a day.

The following day, instead of taking the path by which we had come up, I followed the line of moraines on the left bank, the whole way to Punmah. The day being fine and clear, the splendid peaks known in the Survey as Trans-Indus, No. 2, and B. No. 15, were in full view, running up into perfect needles of rock when seen from this side. Up the glacier the view was backed by the peaks that overhung the Nobündi Sobündi. By evening we reached our old camping-spot at Tsok, and bid good-bye to Punmah and its splendid glacier.

We were now bound for the other main tributary of the Braldoh river, which unites with the Punmah branch some 2 miles above the Glacier of Biafo, and which is called the Biaho River. Thanks to the Shikaries of Askolè a secure rope-bridge spans the torrent at a spot called Dumordo, which we crossed on the morning of the 15th.

Our first halt was at a spot called Burdomül, at the commencement of some ugly slopes of clay and stones, having deep gullies cut through them from the ravines above. At times these are the lines of watercourses; now they were all dry. The sides of these gullies were very steep, so that we had to cut out steps in order to cross them. The men also had long staffs, with a short cross-piece of ibex-horn at the end, which the Shikaries of these valleys always

carry to aid their steps along the steep mountain-sides. After passing these slopes the river-bed widens out to about  $1\frac{1}{2}$  mile, the Biaho flowing along in numerous channels, large and thick deposits of clay and angular rocks lying upon the mountain-sides, with a high face of cliff cut clean through wherever a ravine above occurred. At the foot of these cliffs were narrow belts of thorny scrub, with coarse grass, full of hares; these, scared by the large party that suddenly broke in upon their solitudes, every now and then scampered away in full flight up the hill-sides.

The weather was still overcast, but through a break in the clouds I once fancied that I recognised the form of Peak K 2. At 2 P.M. we came in view of the Biaho "Ganse," or Glacier, with a breadth of  $1\frac{1}{4}$  mile at its terminal cliff, and which, from its height and vast slope of débris, showed that its thickness was far greater than the Punmah Glacier.

We reached the foot of the glacier at 4 P.M., and camp was pitched about 600 yards distant. The Biaho comes roaring from an immense cavern in the ice-cliff immediately opposite, and the noise of the rolling boulders as they came in contact was heard incessantly from under the water. From the spot we occupied, only about 2 miles of the surface of the glacier was visible, very steep and rugged, and I could see only one spot where it looked at all feasible to make the ascent of the terminal débris. Above the line of ice there shot up sharp needles of granite rock, the ends of the projecting spurs from the range which separates this valley from that of the Punmah.

Within the last 4 or 5 years the main river has moved its place of exit from the left to the right bank. With this change the gold-washings, formerly existing here, are no longer profitable. From the fact that gold has been collected here it is clear that the Masherbrum range, which separates the waters of the Nubra and the Braldoh, is the auriferous source, and is that which sends down its ravines those golden sands, which, more particularly in the Kapaloo district, give employment and subsistence to so many men during the winter months.

On the 17th we again left *terra firma* for the region of ice, amidst which we were to remain for some days. No one had been this way since the days when the track to the pass into Yarkund lay in this direction, which was about the time that Ahmed Shah became Rajah of Skardo, a man of whose civility and assistance Mr. Vigne, in his *Travels*, makes grateful mention. The memory of this native ruler is still cherished by all the people of this part of the world, who sigh and wish in vain that the Balti Rajahs of Skardo might once more reign over them.

We got over the terminal slope of the moraine after about an hour's heavy work, and reached the summit of the slope. We now

found ourselves on an open and nearly level expanse of shingle, with a few large blocks here and there. The slope was not greater than  $4^{\circ}$ . The ground we stood on looked exactly like an old shingle-beach, and all were delighted at its seemingly smooth surface; but the level plain proved to be a succession of deep hollows and long valleys, separated by ridges of shingle, which being all of the same colour produced the appearance of a uniform level surface. The labour of descending and climbing out of these hollows was very great. No direct line of march could be kept. When the slopes became great, and when stones lay on the ice these came down in masses; a constant look-out a-head had to be kept, and long rounds taken, so that at the end of the day's work I found that we had only gained  $4\frac{1}{2}$  miles in a direct line, measured on the plane-table. The rocks on either side of the glacier rose in sheer cliffs of 1000 ft. and upwards, and the ice was so broken up near the sides that it was difficult to get over it.

Close to our camping-spot the dry hollows, amongst which we had all day been wandering, became replaced by hollows filled with water, forming lakes of all shades of yellow and green, others as clear as crystal, through the waters of which you could see to a great depth. Other pieces of water, where the side was a cliff of ice, were covered with large floating blocks. The small waves work out lines at the water-level and undermine the ice, which every now and then breaks away, and falls with a tremendous bang into the deep waters beneath, sending high waves across the expanse of still water. Showers of earth and stones also keep slipping off the ice-slopes into the water during the hours that the surface-ice is melting; and our coolies amused themselves in helping the larger blocks over the edges. These lakes measure 500 yards or so in length by from 200 to 300 in breadth, and were to be met with for more than 2 miles along the centre of the glacier which here was very level.

The night was bitterly cold; a fresh easterly wind blew from the direction of the snowy peaks at the head of the glacier; nor could we afford much fuel, for all our wood had to be carried forward with us. Next day the ground was similar to that of the day before, up to 10 A.M., when the moraines became more defined and their ridges flatter: there was more ice, and the débris was larger and more dispersed. Streams began to appear traversing the surface, then losing themselves in cavities; and there were good straight bits of a quarter of a mile, with no need of detours. About 2 miles up from the end of the glacier the medial moraines became quite distinct from one another. Enormous blocks were to be seen on every side, some perched up on knobs of ice. Some, lately fallen, lay by the sides of their old supports. The northern side of the ice was still a confused heap of débris,



pile upon pile, with deep trenches and gullies, and was quite impracticable as a line of march. By means of ropes, poles, and hatchets most places can be passed; but I always found that the shortest plan was to make a circuit where it could be done, and so avoid all difficulties. The scenery along this glacier is magnificent; on both sides large tributary glaciers descend from the Mustakh ridge on the north, and that of Masherbrum on the south. None of those on the north are less than eight miles in length, and the ridges whence they have their sources have an altitude of 22,000 feet. These lateral glaciers were separated by sharp precipitous ridges of granite, from which spikes of rock jutted up here and there. Peaks K 3 and K 3a (Güsherbrüm) were visible, towering up ahead; but I had all day been looking out in vain for Peak K 1 (Masherbrum), which I wanted a sight of in order to fix my distance up the glacier. So, leaving the men to pitch camp in as sheltered a place as they could find, I pushed on ahead, and on my rounding a spur, the great peak came into full view—one vast mass of ice falling on all sides into glacier. The pale ochre-coloured rocks showed here and there only, and in beautiful contrast to the pink-tinted snow of sunset, giving an appearance of much greater distance than the reality, for its summit was only 6 miles from me in a direct line. From the Nubra River I had reached, in 1861, to within 4 miles of the summit of Masherbrum: nearer approach on this side would not be easy, as the glacier-drainage runs nearly due east and west, close at the back of the northern face. The mass of snow, with the two cone-shaped peaks (K 3 and K 3a), was called Güsherbrüm (fine-gold) Peak.

This night on the glacier was dreaded by us all; for in the evening the wind from the east sprung up again, and the cold became intense. The ice was much exposed, the valleys between the ridges of moraine being bounded by cliffs and slopes of glassy ice. At sunset every puddle and lake in the glacier began to film over with ice, which in the morning was more than an inch in thickness. The wind blew all night, getting stronger towards morning; and I pitied the poor coolies with only the rough, sharp stones to lie on, and separate them from the ice. The Balti, who carry only one rug, huddled together two or three under the same covering. Mahomed told me next morning that he heard them saying, "Would that the Sahib felt it as cold as this! he would soon go back." Few, if any, got any sleep; and all were right glad when the sun rose over the peaks ahead.

As yet I had seen nothing of the great Peak of Karakorām (K 2). I knew that it could not be far off, but began to have some doubts as to whether it might not be beyond the Karakorām watershed. The end of one of the spurs from Masherbrum seemed the only accessible place whence any sufficient altitude could be

attained, and so we made for its base, across the moraines and ridges of ice. The foot of the ascent reached, we found good footing for about 1000 feet, and then came some steep rock; after this another slope was gained. When we reached the ridge of the spur, Masherbrum came into view. Eagerly I had looked, whenever we stopped to take breath, along the line of snowy mountains to the north in search of the Great Peak; and now, fixing the position on the plane-table, I showed those with me the mountain behind which lay the peak I had toiled up so far to see. Following up the ridge, another 1000 feet of elevation was gained, when a distant bit of rock and snow could be seen just peering above the nearer snow-line. After another sharp push up to a point where it was impossible to mount further, there no longer remained a doubt about it. There, with not a particle of cloud to hide it, stood the great Peak K 2 on the watershed of Asia!—the worthy culminating point of a range whence those waters have their sources which drain such vast regions. The elevation of Peak K 2, as determined by Capt. T. G. Montgomerie, B.E., is 28,265 feet.

A direct line of glacier stretched away for some 14 miles in the direction of the fine cone of snow, K 3, and, at its base, branched to the right and left towards the Peaks K 1 and K 2. From where we stood the moraines appeared like mere threads—some could be followed up to their sources, growing finer and finer till they disappeared. Every ravine sent forth its stream of rocks, and these, though they joined one another, never commingled; then came sweeping down the expanse of ice, which was never less than 2 miles broad, in beautiful curves, and some fifteen distinct lines of different colours could be counted. Along the centre of this glacier a white line extended, consisting of huge masses of ice in detached blocks, some long and ridged, others pointed, but all in a perfectly continuous line, and which gave the idea that they had been forced up. Further down the glacier they gradually disappeared, the last mass being about a quarter of a mile from its nearest neighbour, but still in the same space, between and adjacent to the same lines of moraine. I had never before seen this feature on a glacier, nor since; nor have I read of anything like it in any of the descriptions which have been given of glacier phenomena.

Looking down on the vast mass of débris which lay below us, a few large tarns of emerald water occurred at intervals. Directly facing, and across the breadth of ice, were large tributaries from the direction of the Mustakh, having steep slopes, and consequently fissured, and broken up into huge blocks and needles of ice. Over the depression to the east of the Peak of Masherbrum, and which terminates the Atoser Glacier of the Hūshè Valley, in Kapaloo, might be seen a few peaks on that river. Whilst the guides under

Mahomed were building up a cairn, I took a sketch of the glorious view. K 2 is a conical mass, with sides too steep to allow the snow to rest on them long; it lies, therefore, only in large patches and stripes on the fissured surface. The sketch done, and having put the highest stone on the pile, we descended to the glacier below.

Next day's camp was pitched in the deep hollow of an old lake, its high banks of débris giving extra shelter, and keeping away the cold from the ice beyond. The spot though snug, was perhaps by no means safe. I have seen such glacier-lakes full to overflowing in the evening, with the ice forming over the surface, from which on the following morning the water had disappeared, having left no record but the sheets of ice jumbled and piled about like huge panes of plate-glass. I believe that they fill thus rapidly and suddenly by the rush of waters along the numerous drains and channels which traverse the interiors of these glaciers. In the side cliffs of ice small holes were to be seen, out of which the water came pouring as out of spouts.

To those who may wish to visit this region, I would suggest that it can only be accomplished by some man of influence accompanying the party. On several occasions I saw very plainly that had it not been for Mahomed, we should have come to a dead stop: even he had great difficulty in persuading the men to proceed; but for him they would have bolted, especially at the Mustakh.

The following morning we walked as fast as we could, over the débris, and by 11:30 reached the débouchement of the Biaho River. This glacier, measured along a central line, from its termination up to Peak K 6 is 35 miles in length, but this by no means represents the length of the journey up, which was some 55 miles. The thickness of this mass of ice is about 400 feet or more, estimating it from the terminal position. In the bed of its river was an enormous transported block, standing out like a small island, whose mass defied the powers of the torrential waters, and which showed the position from which the glacier had receded. The day was beautifully clear, and from a spot some 3 miles down Peak K 2 was well seen. Towards evening we reached the first bit of jungle, where I pitched the tents.

Next day we reached a spot called Korophon; and on the morning of the 23rd I decided in following up the right bank of the Biafo as far as we could, and if possible reach some spot whence a good view could be obtained, directly along a portion of its length. This I managed to do from a low knob, some 5 miles up: the glacier was then to be seen stretching right away, up a broad valley between the mountains, at a slope of about 4° and less beyond: right away in the distance, the tops of two lofty snowy peaks could be made out. Having followed the glacier on this side till stopped by precipitous cliffs, we turned on to the ice,

which was much broken and fissured; the amount of moraine was very small, and, at a short distance up, the ice became quite clear, except where along the left bank there was a long continuous line of moraine of great length, and about 500 yards in breadth. The disappearance of moraine at such a short distance from the end of the glacier greatly increases the difficulty of travelling along it. This vast and magnificent ice-stream, which I at first thought might be from 15 to 18 miles long, I now ascertained to be upwards of 40.

There is a way over the chain by this glacier of Biafo into Nagayr, which is 12 marches distant, the glacier being of very nearly equal length on either side. It was by this way that the Nagayr men used to come into the Braldoh and loot the villages; their last raid was some twenty-four years since, when a body of from 700 to 800 crossed over, and carried off about 100 men and women, together with all the cows, sheep, and goats they could collect.

The weather, which had been bad during the early part of the month, became now so much worse that I was compelled to proceed down the Braldoh to its junction with the Basha (these two rivers form the Shigar River lower down), and had to give up the plan I had formed of crossing the R'Zong La into Nagayr, and round by the Nushik La. I left Askolè in the morning of the 24th, and passed Surūngo, Tongnol, and Chongo, near which is a fine spring of hot water (temp. 104·5), with a somewhat unpleasant sulphurous smell, but perfectly clear. The water stands in a basin some 15 feet in diameter and about  $3\frac{1}{2}$  feet deep, on the top of a conical mound of limestone about 30 feet high. The mound is a deposit formed by the water which flows over on every side, and, as much more of this limestone was to be seen about, either the springs must have been at some time more numerous, or have shifted from one place to another. We now crossed the Braldoh to the left bank, by a rope bridge. The stretch of this bridge from the bar on one side, over which the rope passes, to the other bar, was 276 feet: it was very strongly made, but very slack, so that the descent at starting, and the ascent on the other side, were by no means easy. The ropes are made of birch-twigs—9 ropes form the footway, with 9 on either hand to hold by.

My camp this morning was near the village of Puskora, on the left bank close to another rope bridge, which we crossed on the 25th. The scenery about this spot was wild and grand, and the river, being somewhat confined, went tossing and roaring along amongst the huge blocks which strewed its course.

The path from the bridge to the Hoh Loombah was terribly bad, and even dangerous in places, from the steepness of the mountain-sides, and from the yielding materials over which it passes, which



give way in great masses. We had this day several tough ascents from, and descents to, the bed of the Braldoh River, close to which, at one place and all within a mile of each other, were three hot-springs, their temperature  $137^{\circ}$ ,  $122^{\circ}$ ,  $117^{\circ}$  F., all sulphurous, the water issued in small quantities yet enough to make good baths if required.

On reaching Chokpojong, I started again at once, so as to reach the summit of the mountain above by evening. A fine view was thence obtained up the Hoh Loombah, with its large glacier and branches. Next day I proceeded to Dusso, and remained there till night, as the Zuks or skin-raft had not come up. On the ridge above Dusso is the holy rock of Shanasir Pir, which is an enormous round block of granite, jutting out just below the ridge, but overtopping it. The block itself is quite inaccessible, and all the people tell you so, and it is this I suppose that constitutes its sanctity; but they also add that on the top is a velvet embroidered cushion, a lump of gold, and a white spotless fowl, and that it is the residence of the Pir. The rock is held in great reverence and the people salaam to it every day; nevertheless the villagers of Dusso and Nigit are about the worst of any about here, and many a thing is laid to the account of the Shanasir Pir, which may be well accounted for otherwise. Thus any small article which might be missing in the morning, was gravely said to be a miraculous disappearance by his intervention. The skin-raft arrived in the course of the night, and the next morning we went down to the river and embarked. The men expected that we should reach the opposite bank near a large rock; but though they exerted themselves to the utmost, we soon saw that this was quite impossible, and we were swept past it some 50 yards distant, and went down the river at a mad pace, causing that curious feeling of excitement which a sense of some coming danger always produces; nor were we long kept in suspense. The boatmen or rather raft-men behaved with great coolness, and steered safely close to the edge of a bank of boulders which lay on the right; we passed also some ugly waves beneath the cliff on the other side. Thus we went along all right for about half a mile. Nothing could be seen ahead but white curling waves and foam, with great black rocks here and there: into the midst of this our raft glided. Mahomed and the manjis repeated the Kulmah or Mahomedan Creed in a rapid whisper, as we were carried over the crests and down again into the troughs between the curling waves. At one time I did not expect that we should come out of them; for whilst in the trough a great wave broke right over our frail raft, and completely buried us. I held on, but for several seconds did not know whether some of my people had not been swept off. For a moment we came to the surface, the manji shouted, "Ya Ali, hold tight!" and in

another moment another great wave came down upon us. When at last we came out upon the smooth water below, and looked back up the rapid we had just come down, every one breathed freely again, and the "Thank God" of each was never more sincerely uttered. The manjis salaamed low to Pir Shanasir, to whom they said they owed their lives. Wet through and shivering with cold we walked on briskly to the village of Tandoro on the Shigar River, near which place we had to cross preparatory to a trip up the Basha branch.

Before taking leave of the Braldoh something more as to its trackways may not be out of place. The principal exit from its valley is that to Yarkund over the Mustakh. According to the reports given me, the glacier on the northern side is as long as that on the southern, but in my opinion the journey would be longer, as I do not think that the way lies down its main stream, but that the main body of the ice would be towards the great Peak K 2, with another from the Peaks of Nobündi Sobündi. About four marches from the Mustakh Pass a track branches off to the westward, up a lateral stream, and over a ridge to the Hünzè river, by which the Braldoh people have often gone, as being safer than by Nagayr, with the people of which district there are old feuds. It is by this way, at the back of the main Himalayan ranges, that the Hünzè people, and other robber tribes on that side, proceed when they rob the kafilahs, or bodies of merchants and other travellers, so that this route is now discontinued as a line for commerce, and is only taken by a few Baltis who have settled in Yarkund, and who cross over now and then to see their old friends.

Many years ago the main traffic lay up the Baltoro Glacier, and turned off up a lateral ravine to the left, and so over the Mustakh, some 12 miles, to the east of the pass now in use. This former pass became impracticable owing to the great increase of snow and ice, and Ahmed Shah ordered a search to be made for some other way over, when the present passage was fixed upon. Leaving out of consideration the tracks near the villages and towards the end of Punmah Glacier, the way along its side and across it might, with a little labour, be made practicable for ponies. Even were there more foot-traffic during the summer months than at present, it might be worth while to see to the more difficult places, but at present this line is wholly disused for a month at a time. The few travellers that go this way do not know the places where the deep fissures lie, and hence there is great loss of time in wandering about in search of a proper direction. The ascent over this pass is very gradual the whole way; ponies and yaks have frequently been brought over from Yarkund. The line from Skardo to Yarkund joins that from Leh in Ladak, near Mazzar.

One of the most curious and suggestive features to be observed in the Braldoh valley is connected with the great glacier of Biafo. Crossing the transverse valley into which it descends with its vast mass of ice, and abutting on the cliffs on the opposite side, it forces the river to flow at the foot of these, though in some places it is completely hidden, coming into view only here and there. This relative position of the Biafo Glacier to the Braldoh valley produced many years ago—how many I could not ascertain—one of those cataclysms to which the Upper Indus is subject. The valley of the Braldoh became wholly obstructed with ice, and the whole of the broad expanse above of sandbanks and lines of streams became converted into a deep lake, which extended several miles upwards. Thus it continued for some time, and when the waters at last broke through their icy barrier, the damage done seems to have been considerable. The greatest flood chronicled in the traditions of this region is that which took place along this very tributary to the Indus some 200 years since, when the village of Spanboo was quite destroyed, and its Musjid carried almost entire into the Shigar River. This was considered to be a miracle, and its timbers were accordingly re-erected in one of the villages on the left bank, where they remain to this day.

The grazing-grounds of the villages of the right bank of the Braldoh lie up the Thla Brok and neighbouring ravines; those of Askolè are immediately above the village, whilst the villagers further down have to take their herds and yaks up the spur above the camping spots of Tsok and Punmah. The goats of this valley are very handsome, with fine curling horns like those of the Markore.

The villagers of these regions have but few personal wants, and all are obtainable in the valley. They dress entirely in puttoo, or woollen cloth, which they make themselves: cotton is never used, not even for turbans. Their knowledge of the world is almost limited to their own wild ravines, and though many may have crossed the Mustakh, I met with very few who, in the other direction, had been beyond Skardo. During the winter months the men are engaged in hunting the Ibex, when these are driven off the higher ground by the snow and come down to the streams. The animals are run down by dogs, which they take great care of and prize highly. The dogs are trained to get above the Ibex, and so drive them to spots below, where the men are ready with their matchlocks. The Ibex seems to have the greatest fear of the dogs, and, instead of bounding away, will run and then crouch behind rocks on their approach, but taking little heed of the men. In several places I came upon the small, strongly-built huts, where the people place the venison, which freezes and keeps till they return to the village below. About Askolè were fine crops of wheat, beardless tromber, and turnips. Peas are sown at the same time

with the wheat. At the time of my visit they were green. Hay is made towards the end of August, and is put up in large cocks on all the large blocks about, whilst all the house-tops are covered in like manner. The fodder is excellent, containing a good deal of lucern.

I now proceeded to survey the Basha branch of the Shigar River. The skin-raft from Shigar being still in camp and the manjis (boatmen) having found a good place for crossing the river, opposite the village of Yūno, I left Tandoro on the 28th of August, and landed safely at the village of Kaiyu, in Goobalpur. The villages passed on the right bank of the Shigar are well irrigated from the small glaciers of the second order, which lie on the ridges about the Peak B 21. They are also well wooded, the walnut-trees especially being very fine.

Next morning the Mountain of Koser Gunge, opposite to us, formed a beautiful sight from its fresh whitewashing. Rain with wind kept sweeping in heavy storms down the Basha River during the day; but we managed by evening to reach Chūtrun, passing on our way over a very difficult piece of ground near the village of Tsogo by means of ladders and planks. A recent inundation had wrought great changes about the village of Tisir, having destroyed all the cultivation near the stream, which now lay buried beneath sand and detritus, with blocks of large size. Some eight or ten houses had also been completely covered, and large trees had been torn away by their roots. The villagers said that it had been caused by the bursting of a glacier lake that took place in the month of July: part of the village of Koshūmūl, on the left bank of this same river, had also been swept away, owing to an unusually wet season, causing "shwās" in the ravines. I was glad to find that some improvements had been made near the hot spring at this place (Chūtrun), and that a neat little bungalow had been built for the use of the visitors. The hot spring here (temperature 110° Fahr.), gives the name to the village, from "chu," water, and "trun," hot. The water is as clear as crystal, and without any taste or smell. The valley from Chūtrun upwards towards Arundu, in respect of its picturesque beauty, may be said to surpass everything on this side Skardo, ending off as it does in the glorious glacier of the Chogo Loombah. The villages are well wooded, standing on the lower slopes amidst groups of fine walnut-trees. A kind of arbele poplar also grows here, but the apricot does not thrive; and though apples and pears ripen, they are of inferior kinds. The whole of the road to Arundu is excellent travelling. This adds greatly to the inducements which this valley offers to visitors, and it is well worth visiting by all such as may reach Skardo.



It was necessary to fix some point well at the angle where the Basha River valley, turning from due north and south, takes a course west to Arundu, and so shuts out all the trigonometrical points in the Shigar River. I left Doko very early, and, after climbing a succession of grassy spurs, reached, at 3 p.m., the edge of a glacier of the second order, some 1500 feet above which a rocky slope extended, ending in a jagged ridge of bare rock. We crossed the glacier, and commenced the ascent, reaching the summit in about an hour. Much as I had been accustomed to the grand features of these regions, I do not remember that I ever experienced a feeling of astonishment so great as when I saw the view which here presented itself. For my survey work no point could be better; higher it was scarcely possible to proceed along the ridge to the south-west. Of the scene itself I can only venture to indicate the component elements. To the north-west there was the great glacier of the Basha, with the little village of Arundu at its termination, its fields touching the ice. On the west there was Peak B 14, or Haramosh, with its fine summit of eternal snow towering above all the minor cones, and from which the lateral feeders in that direction were evidently derived. But the Nūshik La and its glaciers were not visible, being shut out by the great intervening mass of ridges, and spurs, and glaciers.

Next day, after having been benighted on the mountain slopes, where we passed a supperless and a sleepless night, we started again for Arundu. I was much struck with this place, there is so much that is novel and curious, even to a mountain traveller. Not the least of these is to see agriculture going on close up to a glacier of so large a size. The remainder of our day here was employed in preparations for our trip to the Nūshik La, or Pass, from this valley into Nagayr.

On the 3rd of September the weather was again beautifully fine, and I started at 10 A.M. We had to proceed up the right bank of the glacier for about half a mile in order to cross it, and so enter the valley of the Kèro Loombah, which here joins the Basha from the north. This crossed, the track lay up the right flank of the Kèro Loombah, and for 4 miles, as far as the glacier of Niaro, was wretchedly bad. From the opposite moraine, after crossing the glacier, a curious scene presented itself. As the glacier abuts against the cliffs of the left bank of the Kèro Loombah River, it had, when much larger than it now is, so completely stopped the waters of this river as to form a large lake. This happened some ten years since. Before the formation of the lake, a wood of birch-trees, some of large size, covered the valley, and these, when it became filled with water, had all been killed; and there they now stood, with all their gaunt white stems, which, taken with the other features around, made up as desolate a scene as can be well

imagined. A few willows were beginning to shoot up again, whilst the bottom of the old lake was grown over with a high jungle of rank grass. The size of this lake was about 2 miles long, by half a mile broad. From the line of the destroyed trees it was 200 feet deep. This line was well marked by the birch-trees growing along the hill-side, which were on a level with the moraine of the Niaro glacier. The lake continued as such for rather more than a year and a half, and, fortunately for those below, it subsided gradually, having taken about a month to discharge itself. Here I pitched our camp, and on the next morning (the 4th) we proceeded to the foot of the Kèro Loombah, the walking being generally over plateaux of high grass, birch growing in plenty on the mountain-sides. Traces of bears were frequent, but we did not come upon the animals. As we skirted the glacier, evident signs that it was now on the increase were constantly to be seen in the masses of upturned and broken turf.

About  $1\frac{1}{2}$  mile further up, a lateral glacier descended from amongst the mountains to the west, and the spur bounding it to the north being practicable, I determined to fix the position. I ascended till the snowy peaks Trans-Indus 2 and Trans-Indus 4 could be seen above the bounding range of the Kèro glacier on the north, while Trans-Indus 11 to the south-east gave me my position very correctly.

The Kèro Ganse here divides into two, that to the W.N.W. leading up to the pass; that to the E.N.E., of equal length, descends from the mountains, which also bound the Hoh Loombah of the Braldoh valley, but which are quite impassable. Other smaller ice-streams from the peaks of the intervening ridge give each its quantum to this branch.

I descended, and accomplished 2 miles more up the main glacier that day, encamping at a spot known as Kùtchè Brausa, on the edge of a little green tarn of water. Next morning we crossed the glacier for 4 miles, diagonally, to the left bank, and left it at a place known as Ding Brausa. Ascending some 300 feet above it we crossed over a spur, and then took to the ice again, where a lateral glacier from the north descends into the main valley. The ice here is much fissured, and at some seasons very dangerous. It continued bad to Stiakboo Brausa ("Brausa" means "place"), where, on a small spot of bare ground, two small conical huts, or rather kennels (for they are only 3 feet high), have been built for travellers who may be caught in snow-storms on their way over the pass. The narrow strip of moraine here disappears. From this we ascended in order to avoid the deep fissures below, and cut steps, for a distance of 200 yards, along the steep slope of the snow-bed, which runs down into the glacier. Beyond this, on turning due north, the pass of the Nùshik came in sight, up a gra-

dually sloping ice-bed with scarcely a single crevasse, steep cliffs enclosing it on either side. Several of the men felt the height, and had to remain behind from sickness and headache. I scarcely felt it; and I think that the state of the stomach has a great deal to do with these sensations.

The view from this point was superb down upon the enormous glacier below; whilst beyond were the fine snow-peaks of Trans-Indus 2 and 4, sending off large tributary glaciers 10 to 12 miles long. To the east, the view lay along the glacier, which was visible for 18 miles. On the north was one great elevated ice-plain, and the peaks bounding the Nobündi Sobündi glacier. The breadth of the main glacier was more than 2 miles, covered with broad moraines of black, white, red, and grey rocks, according to the tributary ice-streams it takes up in its course. No glacier scene in the whole of the Himalayas can exceed this in the magnitude of all its features. To the westward, the view was shut out by the spurs from the mountain, but the natives with me said that the glacier terminated two days' journey distant, at Hisper, in Nagayr. The descent from the pass to the level ice below is about 3000 feet, and difficult as well as dangerous, being down steep slopes of ice and rock; so that it is necessary to let a man down, with a rope round his waist, to cut places for the feet. After finishing my work we retraced our steps, and at nightfall on the same day got back to the encampment, having successfully surveyed the northern watershed of the Basha Braldoh.

On the 5th of August I started early, and reached Arundu by noon. The next day, at 12 o'clock, I crossed the glacier, as before, to the left bank, and, ascending on that side by the skirts of the Chogo Loombah glacier, reached in the evening the edge of a small glacier lake, about a quarter of a mile square, called Bükpon Tso. These lakes were numerous, and formed a long linear series. They have a desolate look, from the many buried trees (willow and juniper) standing out of the water, mostly dead, the remainder struggling for life in the icy water. Some lakes were covered with masses of ice which had broken away from the glacier cliff. The waters were tenanted by flocks of ducks, but they kept out of gunshot.

We began the 8th by a long ascent up a spur, starting early, but all to no purpose; other spurs beyond shut out the view. So we descended again, and proceeded up the side of the glacier, sometimes walking on the ice, and sometimes on the hill-side. The surface of the ice was more uneven and broken than I had yet seen in these large glaciers, being, in fact, a sea of frozen waves as far as the eye could reach. The small lakes still continued wherever a lateral stream joined the glacier, thus making a barrier to its waters. The appearance of the glacier continued the same the

whole way up, with less débris on one side than on the other, but much fissured. The slopes were covered with grass, and near the glacier was plenty of willow and juniper, forming little woods at the junctions of the streams. The tracks of bears were to be seen in every direction in the sand and mud in the hollows between the glacier and the mountain-side, but they were probably at this time high up among the ravines.

Next day (Sept. 9) we crossed a large glacier from the north,  $1\frac{1}{2}$  mile beyond which, the hill being accessible, I ascended some 2000 feet to a fine knob. But the clouds prevented my doing any good work. It was quite dark when we reached the level of the glacier in the evening, and finding our camp men were not there, had to bivouac out.

The bounding ridge had been fixed by the previous day's ascent, and with the exception of a few lateral ravines and glaciers on the left bank, the survey of the whole of the Basha valley was now complete; so after a more detailed examination of the left bank of the glacier we returned to Arundu under a drenching rain. I made halt the next day, and the morning of the 12th saw our camp struck. It was a lovely day, and our path lay down the left bank and over the level sands below Arundu, afterwards along the hill-sides to the pretty village of Doko.

The whole of the valley drained by the Shigar River was now surveyed, presenting on the plane-table as curious and wonderful a map as can be well imagined. The district may be described as one great area of ice-bound mountains, with long trains of ice debouching out into the drainage lines. The Glacier of Biafo forms the striking feature of this region. The average slope of this glacier is about  $3\cdot5^{\circ}$  to  $4^{\circ}$ . I found that the slopes of these glaciers seldom attained  $5^{\circ}$ , and  $3\cdot4^{\circ}$  may be taken as the medium. On the Chogo Loombah glacier, the ribboned structure is best seen, though it is visible in all; these bands of coloured ice run continuously with the glacier in its length, and cross sections show them dipping towards the centre. On the sides of the glacier this slope was frequently from  $32^{\circ}$  to  $40^{\circ}$ , and increased towards the centre, where the bands were almost, if not quite, perpendicular.

The present thickness of the ice is a point not easily determined; but, judging from striæ in the sides of ravines from which glaciers have retired, from 300 to 400 feet is not an exaggerated allowance for what they once have been. I am inclined to think that it may have been more for parts nearer the river. The ice of these glaciers is many feet higher in the centre than on the sides; it also differs considerably in texture.

Whilst engaged in the work described in the preceding pages,

I have often been struck by the indications of considerable amounts of change of temperature within what we may call our own times. The proofs of this are to be found in many parts of the great Himalayan chain. These consist in the enormous terminal moraines which in so many places abut on the larger rivers, down to which point glaciers must once have descended, and which in some cases must have rivalled in length the present ones of the Mustakh Range. If other evidence be required as to these older glaciers, it is to be seen in the long furrows cut out of the solid rock as if with a chisel wielded by a gigantic hand, but more neatly than any chisel would leave its work. Nowhere are these great striations better seen than in the Shigar Loombah, the ravine from Thyarlung on the right bank, some 3 miles up, where the hard slates have been ground into rounded bosses, and streaked in the line of the ravine.

Among the proofs that there has been a change of temperature of recent date are the following. Many Passes which were used even in the time of Rajah Ahmed, Shah of Skardo, are now closed. The road to Yarkund over the Baltoro glacier which before his time was known as the Mustakh, has by the increase of the ice near the pass become quite impracticable. The men of the Braldoh valley were accordingly ordered to search for another route, which they found in the present pass, at the head of the Punmah glacier above Chiring.

Again, the Jusserpo La can now be crossed only on foot; whereas in former times ponies could be taken over it. The pass at the head of the Hoh Loombah is now never used, though there is a tradition that it was once a pass; no one, however, of the present generation that I could hear of had ever crossed it. Certain large glaciers have advanced, such as that at Arundu, of which the old men assured me that in their young days the terminal cliff was  $1\frac{1}{2}$  mile distant from the village. Mr. Vigne says, "it was a considerable distance," it is now only about 400 yards. A like increase has taken place at Punmah, where within the last six years the old road has been completely covered by the ice and moraine, and where Mahomed, my guide, told me the old camping ground was, now lies a quarter of a mile under the ice: the overthrown trees and bushes plainly testified to the recent advance which this mass had made; this evidence was equally well seen along the side of the Arundu glacier.

Even so lately as twelve years since, the people of Shigar were enabled to get two crops off their fields; thus the first crop (barley), was followed as soon as cut by a second (kungūni) which ripened by the end of autumn. Since that time it will not come to maturity, so that after the barley the fields now lie fallow, and the kungūni has now to be sown earlier in the season.

It was now time for returning to Kashmir, our route being through Punzul to the Alumpi La, and our party had to be divided, owing to the difficulties of the road. The first day I reached the small summer huts of the shepherds, called Matuntoro Klas. I was much surprised to meet with a few scattered trees of *Pinus excelsa*, but heard that they were also to be found in most of the shady ravines of the watershed between the Indus and Shigar rivers. I here lost three days owing to the badness of the weather, and on the morning of the 18th marched by a zigzag course up a steep slope to the pass, from the top of which there is a fine view of the mountains towards the Braldoh; the Karakorām in the extreme distance overtopping all. Trans-Indus 2, opposite, looked very fine. The last few days rain had given all the higher peaks fresh coatings of snow. Very little could be seen to the south or west, so shut in were we on those sides by high spurs. A good but steep descent took us down to Pakora Klas (klas is a summer hut). Our way thence was through a narrow gorge of limestone (the bedding on either side being quite perpendicular), and, following the left bank of a small stream, we reached the first village (Hūrimūl) on the Tormik River, a considerable body of water coming from the westward, flowing through a cultivated, fairly wooded, and cheerful valley, with grassy spurs running down into it from the mountains above. I followed the left bank of the Tormik, crossing several small tributary streams joining it from the north. The villagers all along were busy cutting grass, or wheat, or threshing it out with bullocks: it was a cheerful and lively scene, which I appreciated the more from the bleak and wild features amongst which I had of late lived.

The next morning looked unpromising for alpine work. I started, however, hoping to make the passage of the Stok La, which I was anxious to cross. Our way lay along the left bank of the Tormik, and was good and grassy. Near the first large ravine from the north, called Tserbrum, there was a hot spring like that of Chūtrun, clear, tasteless, and without smell. Its temperature was only 98°. On reaching the foot of the pass, clouds and snow compelled me to return. The Tormik River has its sources in several small glaciers, and as the survey of the valley was complete, there was no necessity for remaining. We reached towards evening the small but prettily-wooded village of Kūshipa, down the Tormik valley.

On the 20th I proceeded towards the junction of the Tormik with the Indus. We were obliged to camp on the ascent in the midst of falling snow, and the next morning mounted the remaining portion, before the sun rose from behind the mountains to the north of the Indus. On gaining the highest point there was a glorious view of the peaks covered with fresh snow. To the southward, and

up the Indus towards Skardo, fine grazing ground lay beneath us, and some hundreds of sheep were seen coming up from the klas below. It was a long and tiring descent to the Indus. We reached the rope-bridge at Mendi by 3 P.M., the longest and best specimen of these bridges which I had seen, being swung quite 150 yards above the river, from the face of a sheer cliff on the right bank. Its length was 110 feet, the path down to it was well made of spars and beams overlaid with flat stones, with a few ladders here and there. The bridge, with the river below flowing smoothly along between its precipitous cliffs of rock, and the foot of Mendi beyond, altogether formed a striking subject for the artist. On the opposite side I was met by the Dogra Thanadar, and the Balti Rajah, with whom I walked into the village of Mendi Khur. It is an odd-looking place, built on the banks of a large stream flowing from the snowy range between Ronyul and Astore. This has cut itself a deep and narrow gorge through the granite rock, which is spanned by a good wooden bridge. The houses are built amongst the rocks on either bank, and aqueducts of hollowed trees are carried in every direction along the face of the cliffs and across the gorge, conveying water to the houses as well as the gardens.

On the 22nd we started early in the direction of Skardo, along the left bank of the Indus—part of the road lying along the slippery faces of the cliffs, and very dangerous. We camped under some overhanging rocks opposite the village of Byicha, which sent a deafening echo back from the river, roaring past close by. About a mile and a half further on, after leaving camp next morning, we reached another bad part of the road. It was of exactly the same kind as that we had passed the day before, consisting of a series of ladders placed against the nearly perpendicular face of the cliffs; but the ladders were more dangerously placed, and some of them very rickety. This route should not be attempted by any one liable to get dizzy on looking down from great heights. The ladders often rested only against pieces of wood driven into cracks in the rocks, and on looking through the rungs as you go up, the view presented is that of a great river rushing along like a foaming torrent, at the base of vertical cliffs, which descend 300 feet sheer beneath one's feet.

After reaching the top of the last ladder the path enters a deep cleft in the rock, which for several yards is quite dark. Climbing up two or three more ladders in this, we at last emerged into the light, again to descend upon the river. Our path now continued good for three miles, running close to the river: we then reached the foot of a steep face of rock, the river flowing sluggishly at its base. Our guide here informed us that we must strip and wade. The water was dreadfully cold and reached up to my armpits.



We then scrambled up the cliffs to regain the pathway; thenceforward the road was good all the way to Krabathang and Basho, the road to which branches off at the former place, ascending over the very high spur, called the Kutchi Bore La, the camping-spot being on the summit. Between this pass and Mendi Khur the mountains of the south bank begin to be more wooded. *Pinus excelsa*, the tall silver-fir, and birch, are seen in dense patches wherever the slope admits of their growth.

The camp being pitched at Basho, I ascended a low spur above the village to get a view of the large stream which here joins the Indus. Glacier action of former times, was here very apparent in the great masses of angular rocks above the village: the stream comes rushing down over these for about a mile and a half above it, winding down a gently sloping valley, with high mountains on either side. This enormous collection of angular rocks is the terminal moraine of a large glacier, the remains of which are to be sought higher up, and where now it is only some four or five miles long, with broad feeders from the mountains on the west side.

On the 24th we still followed the left bank upwards, as far as Kutzurah. There is very curious ground near Kutzurah, which is situated at the western end of the Skardo Basin, where the Indus begins to flow through a confined channel: the features which attract attention are low undulating rounded hills, composed entirely of angular rocks, but no surface-earth whatever nor sand. In the midst of these and close to the village is a pretty green lake, about 600 yards long by 250 broad, of beautiful clear water, from which the mountains around are reflected as from a mirror: its stillness is only broken by the occasional rise of some fish. This lake is called the Forok Tso.

The country around Kutzurah is well wooded and clothed with verdure. We now left the Indus valley to proceed up a large tributary which it receives from the south. Two miles above the village we entered a level valley, about half a mile broad, between steep mountains, the river flowing through it in a succession of deep pools and winding reaches. At the end of this valley is the small village of Tsok, beyond which the valley narrowed to 200 or 300 yards, and was dotted with large clumps of willow-trees, the stream flowing in four or five channels. On the following day (25th) our march still lay up the valley: the level bit soon ended, and two miles further the waters of the stream came roaring down over and among the large angular blocks of an ancient moraine. As we ascended, the hills became better wooded, and the cher (*P. excelsa*) here was of tall growth. About 9 A.M. we reached the village of Stokchün, and by noon arrived at Shigarthang, a wild dreary-looking place, at the junction of three large streams—the Dora Loombah from the direction of the Boorje La, the Munder Loombah

and the Alumpi Loombah. Close to the village are two substantial guard-towers, built at the time when the various rajahs of Baltistan were at war with each other.

Shigarthang, standing on a plateau at the junction of four valleys, gets every wind that blows, and in winter is dreadfully cold, its elevation being 10,200 feet. The sheep of the district are remarkably fine. From this place towards the Alumpi La the valley is open, grassy, and nearly level: the banks of the stream are fringed with willows, and junipers stand scattered about over the lower slopes of the mountain. About  $3\frac{1}{2}$  miles further on is the junction with a stream from the R'Bunnoch La, distant some six miles; one of the roads to Astore over a small but crevassed glacier. On the 27th we ascended the pass of Alumpi La, where we came upon the skeletons of several men which lay bleaching on the rocks, the remains of some unfortunate coolies who had been overtaken by snow-storms and had been frozen to death. Half-way up the ascent, in a small hollow, was a deep and beautifully clear tarn of water: three more skeletons lay here, their loads on the ground beside them, one being still fastened to its bearer. These spectacles were not very cheering to our party, for they could not fail to remind one that the same fate must happen to ourselves should a snow-storm come on—for it would be impossible to advance or return over such ground as we were now on. Another steep bit of rather more than 1000 feet above the tarn brought us to the pass, where more bones and rags, and broken kiltahs told the dismal tale of many a man's last hours of suffering, in his unsuccessful fight with the elements. Fifty men had perished here—coolies proceeding from Kapaloo to Gilgit with supplies.

By this time the day had suddenly changed: huge rounded masses of cloud were rolling up over the Deosai plains, and all the high peaks were hid. The Nanga Purbet, which I had hoped to see in all its beauty and grandeur across the valley of Astore, was quite obscured. I found the level of the pass by boiling thermometer to be 15,200 feet. We left this desolate spot as fast as we could, for the clouds were gathering and becoming very threatening: fortunately we cleared the zone of angular débris before the snow began to fall. The wind was gusty, very strong, and cuttingly cold the whole way to Boobin, a small place of three huts, the first habitation on the Astore side. I found the people here very different from those of the other side; the language even had changed, though the Balti predominated in it. And now, when my steps were bent towards Kashmir, I seemed to feel that for the present I had had enough of ice-fields and glaciers. The field-work for the season was at an end.

The valleys of Astore resemble those of Kashmir rather than those of the other side: they are broad and open, and are bounded

by forest-clothed hills of pines, the streams flowing along quietly. The Dorè La will be found the best pass into the valley of the Kishen-Gunga. The ascent is gentle and open, and the road excellent the whole way into Kashmir, crossing the Raj Diangan Pass to descend on the Wuller Lake near Bunderpur.

IV.—*Reconnaissance Survey of the Lake Districts of Otago and Southland, New Zealand.* By JAMES M'KERROW, Esq., District Surveyor to the Province of Otago.\*

*Read, January 25, 1864.*

*Mountains and Lakes.*—The most marked and striking feature in the configuration of the country now under consideration, is the great and sudden differences of elevation that diversify its surface; the elevations take the form of mountain ridges, and the depressions that of gorges, valleys, and deep rocky basins, the latter filled by lakes. The mountains rise from 4000 to 9000 feet above the sea-level; and as the line of perpetual congelation is 8000 feet above the sea-level (as determined last year from the reconnaissance survey of the Wanaka and Hawea Lake district), it follows that all elevations greater than 8000 feet are within the glacier-producing zone. The highest parts of the Forbes and Humboldt Mountains are within this zone, and are covered with ice; they are parts of the great icefields that congregate around Mount Aspiring as a centre. The Earnslaw glacier, although only covering about a square mile in extent, is still, on account of its position, a very imposing object; it lies on the south side of Earnslaw, at an elevation of from 9000 feet down to the melting point; it is 15 miles north by east of the head of the Wakatipu Lake; and, as seen from any part of the most northerly 20 miles of it, is by far the most attractive object in view. The lie of the country is nearly from north to south; and while the mountain ridges individually range in that direction, they may, when taken in the mass, be more correctly described as lying from N.N.E. to S.S.W., and that being directly athwart the track of the almost constant winds from the Pacific Ocean, their influence on the climate of the country may be considered as of the highest importance; for not only do they break the force of these winds, but their cool tops condense the vapours into showers that might otherwise pass over so narrow an island without parting with a drop. The height of the ridges causes the downfall on them to take the form of snow, which lies on them during the greater part of the year; this circumstance,

\* The original Report appeared in the 'Otago Provincial Government Gazette,' Oct. 14, 1863.